A Cognitive Adaptationist Interpretation of Reading Disability [1]

Carl Bereiter
Ontario Institute for Studies in Education

Does an injured foot cause one to limp? Not exactly. The limp is, at least in part, an adaptation to the injury. Although the limp may be the most visible evidence that something is wrong, it is not the problem nor even an integral part of the problem. In fact, it is a solution to a problem--the problem of how to move about while minimizing pain and further damage to an injured foot.

In this paper we develop a similar interpretation of the reading comprehension strategies of disabled readers. Passive, low-comprehension reading strategies may be a conspicuous characteristic of disabled readers (Torgesen, 1982; Wong & Jones, 1982). But these strategies, we shall argue, have adaptive value. They are a way of coping with school demands, given that one has poor word recognition ability. What we shall call the minimal comprehension strategy is, like limping, a way of getting along while minimizing pain and further damage.

The Adaptationist Perspective

Before elaborating on the preceding point, it may be helpful to give a more general account of the adaptationist perspective from which it is made. Adaptationist thinking aims to understand characteristics of living things by treating these characteristics as solutions to problems (Bogdan, 1985). Therefore it is concerned with identifying the problems to which characteristics are solutions and with identifying the constraints within which the solutions are worked out. Adaptationist thinking is heuristic--that is, it does not purport to resolve scientific questions but rather to obtain fruitful hypotheses (Dennett, 1983). That is all that will be claimed for the present

---

[1] This research was funded by the Ministry of Education under its Block Transfer Grant to OISE.

effort.

Adaptationist thinking has played an important heuristic role in biology and anthropology, in sociology, sociolinguistics, and social psychology, but hardly at all in the study of mental processes. Commonplace examples come from evolutionary theory. Why does the catfish have a wide, low-slung jaw? So that it can scavenge food from the bottom of lake or river. Such thinking was common even before Darwin (the example cited comes from Lamark). The limitations of this kind of thinking are now being emphasized by evolutionists (Gould & Lewontin, 1979), but no one denies their heuristic value in making sense of species characteristics. Adaptationist thinking applied to social behavior is also common. Every teacher knows that acting up in class may sometimes be adaptive--that for some children it may represent a solution to a problem of need for attention or escape from difficult demands rather than being a direct result of something haywire in the personality system.

Cognitive adaptation refers to the development of information processing strategies that are adaptive to internal or external constraints. A culturally well entrenched type of cognitive adaptation is represented by conventional procedures for doing arithmetic. Although these procedures vary somewhat, they are all nicely adapted to human beings' limited working memory capacities. They permit us to add, subtract, multiply, and divide large numbers while paying attention to only a couple of digits at a time. There are algorithms that involve fewer steps, but that most people cannot handle because they require holding too much information in mind (Huberich, 1967). This example of cognitive adaptation is unusual, however, because it involves explicit, visible operations. The cognitive operations that go on in a process like reading are not available to ordinary observation or even, for the most part, to introspection, and so the study of cognitive adaptation is far from straightforward. Yet, as we shall try to show, cognitive adaptation is an extremely important thing to

try to understand in those cases where people must adapt to an atypical cognitive limitation.

Cognitive Adaptation in Reading

One type of cognitive adaptation has been fairly definitely identified in reading, although it is not usually described in those terms. Readers who are weak in automatic word recognition tend to compensate by making greater use of inferential processes based on context (Stanovich, 1980). This adaptive response is evidently available to good readers as well, who use it when dealing with degraded print that interferes with automatic recognition (Perfetti & Roth, 1981). This adaptation illustrates several typical features of adaptation that are worthy of special notice:

1. Adaptation typically shows many-to-one convergence of causes on outcomes. It does not matter whether the interference with automatic word recognition is external (in the form of bad print) or internal (in the form of any number of possible neurological or psychological conditions that might affect word recognition). The adaptive response (resort to inferential processes) is the same because it represents one of a limited number of possible solutions to the problem of how to identify words rapidly when graphical information does not suffice. The same kind of convergence is found in the biological realm when both aquatic mammals and fish evolve the same body shape: The fish-type architecture represents one of a limited number of solutions to the problem of how a large body can propel itself efficiently through water.

2. The adaptations that are of special interest are those that develop without deliberation or awareness. Intelligent beings, of course, also achieve adaptations that are deliberate and conscious. But these we deal with as examples of planning, problem solving, creative thinking, and the like. Adaptiveness (more specifically, rationality) is presupposed in such cases and so there is nothing further to gain by applying an adaptationist heuristic.

3. Adaptations are assumed to be locally optimal. Implicit in Stanovich's compensatory theory (1980) is the assumption that readers use a mixture of automatic and inferential processes so as to achieve some optimal balance of speed, accuracy, and effort--optimal, that is, in relation to goals of the individual and to the limitations within which the individual functions. To say that the adaptation is locally optimal, however, is to say that it may not be optimal in relation to more remote or long-term goals or with respect to some wider set of conditions. For instance, the balance of automatic and inferential processes that a child uses might not be optimal for the child's future development as a reader. There is no way the child can adapt to future or unknown conditions. (That is where outside intervention by a teacher might be relevant.) Local optimality will be an important idea in the discussion that follows, because a major point of the argument will be that disabled readers develop comprehension strategies that are adapted to classroom conditions but that are radically unsuitable for real-world literacy demands.

The cognitive adaptation that we have been discussing deals specifically with word recognition. In the ideas to be developed in the next section, this adaptation forms one part of a more comprehensive adaptation by disabled readers. We will call this part "top-down emphasis in word recognition," referring to the poor reader's tendency to rely on top-down, knowledge-based processes. The more comprehensive adaptation, of which top-down emphasis is a part, is what we shall call the "minimal comprehension strategy."

Minimal Comprehension as an Adaptive Strategy

The following analysis greatly simplifies what is undoubtedly a complex and highly variable process by which individual children come to cope with their individual reading problems. But the heuristic value of adaptationist theorizing lies very much in its ability to capture a certain simplification that is believed to exist in

real life. This is the many-to-one convergence referred to previously, whereby multiple causes converge on a common problem that has only a limited range of possible solutions.

Such a convergence of multiple causes on a single adaptive outcome is depicted in Figure 1. The question-mark boxes on the left side of the diagram refer to the variety of possible causes contributing to the condition that we define objectively as "slow and inaccurate word recognition." Children having this characteristic are not, of course, all slow and inaccurate in the same way. A large experimental literature is devoted to differences in the specific kinds of word recognition difficulties that poor readers manifest (Doehring, Trites, Patel, & Fiedorowicz, 1981). Regardless of the precise nature of a child's difficulties, however, slow and inaccurate word recognition represents an objective condition to which the child must adapt, and that is the important point in the present analysis.

-Insert Figure 1 about here-

Slow and inaccurate word recognition, then, is treated here not as a symptom or defining characteristic of reading disability (although it may be those as well) but as one of the salient conditions to which most reading disabled children must adapt. The condition need not be irremediable; it need only persist over a long enough period of time that a stable adaptation to it can develop. That seems to be a reasonable assumption about most children who get themselves labeled as reading disabled. Also, where intelligent adaptation is concerned, it may be relevant that the child <u>believes</u> that the condition will persist.

The other major condition to which the reading disabled child must adapt is identified in Figure 1 as "Need to answer text-based questions." Here we refer to the questions teachers ask during reading lessons and in most other academic subjects and also to the varieties of text-based questions commonly posed in workbook exercises and

other kinds of assigned seatwork. Why single out this particular feature of classroom life? There are several reasons:

1. Question-asking is by far the prevalent mode of instruction in schools (Bellack, Kliebard, Hyman, & Smith, 1966). As far as instruction in reading comprehension is concerned, it comes close to being the only mode of instruction (Durkin, 1978-79). Therefore it is reasonable to expect that children will develop reading strategies adapted to the requirements of question-answering.

2. Learning disability classes are evidently no exception to the preceding generalizations. Leinhardt, Zigmond, and Cooley (1981) found students in LD classes to be averaging about 50 minutes a day on indirect reading activities, which presumably consist mainly of question-answering--considerably more time than was spent on actual reading.

3. If children read outside of class for pleasure or for information, their reading strategies should be at least partly adapted to the requirements of these kinds of reading. But poor readers tend to do little or no reading beyond what is explicitly required of them in school (Fielding, Wilson, & Anderson, in press). If this reading is always concerned (insofar as comprehension is concerned) with answering questions, then the requirements of question-answering become the central and perhaps the only requirements to which comprehension strategies must adapt.

Disabled readers may face more stressful problems, such as having to read aloud in class, but having to answer text-based questions stands out as an enduring problem likely to have a formative influence on reading comprehension strategies. Children may, of course, develop noncognitive strategies, such as copying, that free them from having to read anything at all (Anderson, 1984). The question we shall consider, however, is what would constitute a locally optimal reading strategy? That question is important because it has a bearing not merely on children's classroom behavior but on

the kind of literacy that they carry with them into later life.

As suggested in Figure 1, the optimal reading strategy for dealing with text-based questions, given that one is poor at word recognition, has three components. The first has already been discussed--top-down emphasis in word recognition. Classroom conditions set a premium on both speed and accuracy in word recognition. Following Stanovich (1980), we assume that for most reading disabled children the optimal adaptation to these conditions will involve an above-average reliance on top-down processes. The second component of the optimal strategy is to concentrate decoding efforts on important words. The rationale for this component is obvious. Decoding all the words would take too much time and might overload working memory. Therefore it makes sense to focus attention on those words that carry the most information. (How the student knows which words those are is another problem, which we shall say a word about later.)

The final component of the strategy is the most speculative but also the most central to local optimality. It is now widely recognized that even the most literal comprehension of a text requires a good deal of inference (Collins, Brown, & Larkin, 1980; van Dijk & Kintsch, 1983). Readers differ in the amount of inference they carry out, however, and poor readers are found to do significantly less of it than good readers (Franks et al., 1982). The common view seems to be that this is maladaptive--that poor readers would be better off if they did more inferencing when they read (cf. Gaskins & Baron, 1985). Undoubtedly this is true from a life-span perspective, but it is not necessarily true as far as adapting to classroom conditions is concerned.

Consider the reading disabled child who, in keeping with the first two components of the optimal strategy, has rather shakily identified a limited number of words in a text passage and on the basis of this must inferentially construct a meaning to assign to the passage. To be concrete, suppose the child has identified the words,

"Long ago," "Robin Hood," "Little John," "Sherwood Forest," and a few other words of lesser note. What is the best inferential strategy the child could use in order to be ready to answer a question about this passage? One fairly reasonable strategy would be to do nothing at all. Just try to remember the words, and do all of the inferring after the question is asked. If, for instance, the question is "Where did Robin Hood live?" a quick search of memory should easily identify "Sherwood Forest" as the best candidate for an answer. Because this strategy requires remembering a number of isolated items, however, it is probably not as effective as a strategy that establishes a meaningful connection among the words. Such a connection would be provided by inferring that there was some relationship between Robin Hood and Little John and that they were in Sherwood Forest at some time in the distant past. This is the essence of the minimal comprehension strategy--limiting inference to just what is required to establish coherence among the recognized words in a text.

But why should inference stop at this minimum? The reason is that when only a limited number of the words in a text have been identified, there are not enough constraints on possible interpretations of the text. For instance, in the present example, there is nothing in what the child has decoded to refute the inference that Little John was a boy who fled from his cruel master, Robin Hood, and got lost in Sherwood Forest. But inferences that go that far are risky. They can lead to foolish answers and embarrassment. All readers have to restrain their inferencing, and how this is done has proved to be a problem for artificial intelligence researchers (Schank, 1979). It is not clear how one finds the line between too much inference and too little. For the reading disabled child coping with classroom questions, however, the safest strategy would seem to be to err on the side of too little inference.

According to an adaptationist line of thinking, if the minimal comprehension strategy is indeed the locally optimal strategy for disabled readers under classroom

conditions, then we should expect disabled readers of a variety of kinds to gravitate toward this strategy. Not all disabled readers will necessarily arrive at this strategy however. One way to check the claim that it is optimal is see how children fare who do not follow this strategy. In a group of nine reading disabled students whom I observed recently over a six-week period, two deviated in one or another respect from the minimal comprehension strategy. One failed to follow the top-down emphasis part of the strategy. He relied on letter-by-letter decoding to identify unfamiliar words, even in context. As a result he was by far the slowest reader, and in general the least successful. Another student violated the minimal inference part of the strategy. He engaged in wildly imaginative inferencing that carried him far beyond the text, and he could not distinguish between what he had read and what he had imagined. As a result, he initially gave the impression of being psychotic, although with a few weeks of work on comprehension strategies he was able to bring his inferencing within reasonable bounds. None of the students violated the principle of focusing on important words, but it is easy to see how doing so would lead to trouble either by slowing reading down too much or by overlooking key information.

It should also be evident, however, that the minimal comprehension strategy is only locally optimal. Indeed, for real-word survival, it would seem that reading disabled people would be better off adopting the opposite of the minimal comprehension strategy on every count. Faced with a document to sign, an important notice to read, or any such practical demand on literacy, one needs to adopt a maximal comprehension strategy--maximal in the sense of making use of all available resources to increase comprehension. For the disabled reader this would probably mean trying to decode every word, using as much bottom-up information as possible so as to avoid risky guessing, and carrying out extensive, careful inferential analysis to arrive at understanding. The maximal comprehension strategy, in other words, is much like that which a tourist would be likely to adopt when trying to deal with notices or official

documents in an unfamiliar language.

The Minimal Comprehension Strategy as Self-Limiting

Normal readers all become proficient in phonic skills, as indicated by their ability to decode nonwords (Glushko, 1981). Although disabled readers are notoriously poor in decoding nonwords (Doehring, et al., 1981), it is seldom the case that disabled readers are altogether incapable of learning to use grapho-phonemic information. They progress slowly, but developmental studies show that year-by-year disabled readers progress in their ability to decode nonwords (Siegel, 1985). From an adaptationist standpoint, therefore, we have to ask why it is that children who have at least some resources for phonic skills do not somehow manage to put those resources to more effective use.

This question, however, is perhaps better asked the other way around. How do normal readers manage to acquire phonic skills even when they receive little or no instruction? Here it is worth noting that the knowledge of spelling-to-sound patterns that people eventually acquire far exceeds anything that is taught in even the most thorough of phonics programs. So it seems fair to say that all normal readers acquire phonics skills in part without instruction. A reasonable guess, from an adaptationist standpoint, is that comprehension drives the process. Decoding rules that lead to sensible interpretations of text are retained while those that produce nonsense are dropped, and over time this results in a set of rules that produce about as good a mapping of spelling on to pronunciation as the language permits. (The term rule is used here in a purely functional sense; seldom would people be aware of or be able to state the rules they use.)

From this standpoint the minimal comprehension strategy can be seen to have a very undesirable side-effect. Because it involves severely limiting the effort to make sense of text, comprehension fails to drive the acquisition of decoding skills the way it

does for the normal reader. The minimal comprehension strategy is thus a kind of developmental dead end. Such dead end strategies have been identified in other areas of school learning (Bereiter & Scardamalia, 1985; Brown, Bransford, Ferrara, & Campione, 1983). These are strategies that adapt to immediate school conditions in such a way as to avoid the problems and challenges that would lead to development of strategies adapted to the wider set of real-world conditions. Undoubtedly such self-limiting strategies exist in everyday life as well. For instance, neurotic defenses may be thought of as adaptations that avoid ego damage but that in the process also avoid experiences that would promote development of a stronger ego (Vaillant, 1977).

The fact that local optimization can prove maladaptive in the long run is, of course, one reason why societies have things like parents, teachers, doctors, and prophets. Human beings are highly adaptative to the conditions in which they find themselves, but their long-term welfare often requires that this adaptation be tempered by factors lying outside the immediate situation. Adaptationist theorizing has practical value in so far as it can reveal both what is locally optimal about people's adaptations (so as to understand what causes and maintains them) and what is globally suboptimal about them (so as to bring more far-sighted wisdom to bear).

Educational Implications

When the preceding analysis is examined for educational implications, it turns out not to yield any single dramatic idea. But when its implications are put together, they suggest a fairly radical reorientation of educational treatment of disabled readers.

1. Etiology and classification may be even less relevant to educational treatment than critics have supposed. Much of the most sophisticated research on reading disabilities deals with underlying causes and psychodiagnostic categories. Discussions of this kind of research almost always conclude with hopeful remarks

about improvements in treatment that will eventuate from scientific progress along these lines (e.g., Fisk, Finnell, & Rourke, 1985; Mattis, 1981). Even though empirical results have overwhelmingly failed to support these hopes (Arter & Jenkins, 1979), they continually rise from the ashes. The reason seems to be that etiological and classificatory approaches have the great appeal of science, theory, and complexity on their side. Against this, arguments in favor of just teaching children what they don't know sound simple-minded and crudely empirical (note, for instance, the contemptuous tone of Thies, 1985, p. 101).

An adaptationist approach makes it possible to understand why, on the one hand, there can be a complex system of causes resulting in a seemingly endless variety of reading difficulties, while on the other hand the problems that must be dealt with instructionally reduce to a few major challenges, and why knowledge of etiology may not be very helpful in figuring out how to meet those challenges. On theoretical grounds, an adaptationist approach can incorporate the discoveries of psychoneurological research into an explanatory network that takes account of the human capacity for intelligent adaptation. It thus makes for a scientifically defensible alternative to syndrome analysis and other psychometrically or medically inspired approaches.

2. Treatment must somehow alter the conditions of adaptation. This is the most fundamental idea to emerge from an adaptationist analysis. The minimal comprehension strategy cannot be expected to change so long as it remains a locally optimal adaptation to conditions. According to the model shown in Figure 1, conditions could change in either of two main ways. The child's word recognition skills could improve. This would make it advantageous for the child to make greater use of bottom-up processes and to decode more of the words in a text, and this in turn might boost comprehension to the point where a minimal inference strategy was no longer

the most adaptive. Alternatively, classroom conditions could change so that answering questions was no longer such a formative influence on comprehension strategies. For instance, shifting the emphasis from question-answering to summarization would mean that minimal inference was no longer an effective way to meet classroom demands.

3. Educational treatment of reading disabilities should be opportunistic but not prescriptive. This idea follows naturally from the preceding implications. In trying to decide what educational treatment to apply with a given child, an attempt to diagnose the child's underlying problem is not likely to prove very helpful, because it is the child's overall adaptation to reading that has to be dealt with, and this adaptation is likely to show only an indirect relation to etiology. More important is to discover, for any particular child, where the greatest opportunities for change lie. One child might show an ability to catch on to decoding rules, and so that would be a way to move. Another might show a willingness to tackle puzzle tasks calling for detailed comprehension. Another might show an inclination to read for pleasure, given sufficiently easy material. Another might be relatively insusceptible to any direct change in reading behavior but might be susceptible to isolated training in a strategically relevant subskill (Frederiksen, Warren, & Rosebery, 1985). This is not to propose an eclectic, multi-everything approach to instruction. Rather, it is to suggest that finding any way to break out of the child's self-limiting pattern of adaptation should be seized upon, with some reason to hope that this will increase the child's readiness to change in other respects.

4. Training in spelling-to-sound skills is potentially valuable for most disabled readers, but gains from it will tend to be slow and effortful. There is empirical support for this conclusion. Successful instructional programs almost always involve specific teaching of spelling-to-sound operations, but the success tends to be limited and hard-

won (Naidoo, 1981). The preceding analysis provides an explanation that is not simply an aptitude deficit explanation. As suggested previously, an alternative or supplementary explanation is (a) that children following the minimal comprehension strategy tend not to use all the spelling-to-sound skills they actually possess (in keeping with their reliance on top-down processes and the strategy of decoding only important words), and (b) that comprehension does not drive the evolution of better spelling-to-sound rules. In as much as it would be impossible to teach a child all the context-sensitive spelling-to-sound rules that apply in English (see Venezky, 1976), an effective program must discover some way to get reading disabled students to begin developing such rules by themselves.

5. Training aimed at deeper comprehension should improve decoding as well. This inference also follows from the idea that in normal reading development the effort to comprehend drives the development of decoding skills.

6. Treatment should promote more intelligent, self-directed adaptation. It is understandable that disabled readers, given the way they are treated, should develop an attitude of helplessness (Butkowsky & Willows, 1980). But it is also clear that trying to engender in them an attitude of "I can do it if I try" may prove unrealistic (Licht, 1983). Unless children have some understanding of their cognitive strategies and of their consequences, there is nothing they can do but adapt to immediate contingencies. In a variety of experiments with children as young as 10, it has been found possible to engage them actively as coinvestigators into their cognitive processes (Scardamalia & Bereiter, 1983). A case study reported by Brett and Bereiter (1986) illustrates how coinvestigation was used with a disabled reader to help him develop an alternative to his existing self-limiting reading strategy.

Research Implications

Although research on the neuropsychology of reading disabilities has become

increasingly sophisticated in the past 20 years, it seems that research relevant to instructional treatment has remained atheoretical and piecemeal. The sketch of a cognitive-adaptationist approach presented here does not, of course, constitute a developed theory capable of guiding instructional research. However, it does constitute a framework within which it is possible to start formulating a theoretically coherent program of research. The following questions simply suggest the scope of such a program, ranging from detailed studies of cognitive processes to wide-ranging studies of cultural adaptation to reading disability.

1. How do reading disabled children actually read? Research on reading disabilities has been so caught up in the identification of deficits that very little is known about how reading disabled children actually manage to read as well as they do (cf. Cambourne & Rousch, 1982). There is much talk about dysphonetic readers relying on sight vocabulary, but this is surely wrong, since the memory demands of such a way of reading would be overwhelming (Gough & Hillinger, 1980). If it is true, as suggested here, that disabled readers do decode words phonetically but restrict their efforts to key words, then there is the interesting question of how they recognize such words without first understanding the gist. A similar puzzle arises at the level of propositions, where it is found that immature readers attend to propositions on the basis of their individually judged importance (Brown, Day, & Jones, 1983). Surface clues such as capitalization and length probably play a part; but a reasonably coherent model of how poor readers comprehend remains to be developed.

2. How do children adapt cognitively to other salient instructional conditions? Besides oral and written questions, reading lessons typically also involve oral reading. Poor readers are evidently required to do more of this than good readers (Allington, 1982). Having to read aloud in public when one is a poor at recognizing words obviously calls for powerful adaptive strategies. One strategy observed by

Miramontes, Cheng, and Trueba (1984) was to hesitate and let the teacher fill in a large proportion of the words. A strategy I have observed seems to be aimed at getting out of the situation as quickly as possible. It involves reading familiar words quickly, taking a stab at sounding out the harder words, and then producing a rapid rendition of the whole string of words, often losing hold of words that were previously decoded. The result is often what Cambourne and Rousch (1982, p. 64) call "syntactic gibberish," but with a sympathetic teacher the effort is likely to elicit praise for a near miss and immediate relief from the struggle. What needs investigating, however, is how these overt, often socially manipulative strategies, affect the more fundamental development of reading strategies. It seems likely that they would support a minimal comprehension strategy like the one hypothesized here. But it would be helpful to know what the fine-grain effect of different oral reading coping strategies is on the development of reading processes. With some children, for whom oral reading is a large part of their total reading experience, these effects could be profound, resulting in strategies totally geared to pronunciation rather than to comprehension.

3. How do teachers adapt cognitively to reading disabled students? Since teachers are adaptive organisms too, it is reasonable to expect that they should develop locally optimal cognitive strategies that are adapted to the immediate conditions of classroom life but that may be maladaptive when considered in a larger context. It is well known, for instance, that teachers tend to ask poor readers simple who-what-when-where questions, saving the more complex why and how questions for better readers (Allington, 1983; Hiebert, 1983). This is significant from a cognitive adaptationist standpoint because it means that teachers tend to ask poor readers those questions that can be most successfully handled by a minimal comprehension strategy - and to avoid questions that the strategy cannot handle. Thus, in effect, they arrange the environment so as to make the minimal comprehension strategy even more adaptive than it would be under standardized classroom conditions. Ethnographic

studies (e.g., Anderson, 1984; Miramontes, et al., 1984) show striking amounts of educationally dubious adaptation going on in reading classes--adaptations that have the effect of hiding unpleasant shortcomings both in children's competence and in the instructional activities. Is this sort of thing harmless, except insofar as it takes time away from real teaching, or does it support kinds of cognitive strategies in children that blossom into functional illiteracy? Only detailed study of classroom interactions guided by cognitive models of the reading process could determine this.

References

Allington, R. L. (1982). Amount and mode of contextual reading as a function of reading group membership. Paper presented at the National Council of Teachers of English, Washington, DC.

Allington, R. L. (1983). The reading instruction provided readers of differing ability. Elementary School Journal, 83, 255-265.

Anderson, L. (1984). The environment of instruction: The function of seatwork in a commercially developed curriculum. In G. G. Duffy, L. R. Roehler, & J. Mason (Eds.), Comprehension instruction: Perspectives and suggestions (pp. 93-103). New York: Longman.

Arter, J. A., & Jenkins, J. R. (1979). Differential diagnosis--prescriptive teaching: A critical appraisal. Review of Educational Research, 49, 517-555.

Bellack, A., Kliebard, H. M, Hyman, R. T., & Smith, F. L., Jr. (1966). The language of the classroom. New York: Teachers College Press.

Bereiter, C., & Scardamalia, M. (1985). Cognitive coping strategies and the problem of "inert knowledge". In S. F. Chipman, J. W. Segal, & R. Glaser (Eds.), Thinking and learning skills: Research and open questions (Vol. 2, pp. 65-80). Hillsdale, NJ: Lawrence Erlbaum Associates

Bogdan, R. J. (1985). The intentional stance reexamined. Behavioral and Brain Sciences, 8, 759-760.

Brett, C., & Bereiter, B. (1986). Cognitively-based remediation in reading. Paper presented at the annual meeting of the American Educational Research Association, San Francisco.

Brown, A. L., Bransford, J. D., Ferrara, R. A., & Campione, J. C. (1983). Learning, remembering, and understanding. In J. H. Flavell & E. M. Markman (Eds.),

Handbook of child psychology: Vol. 3. Cognitive development (4th ed.) (pp. 77-166). New York: John Wiley & Sons.

Brown, A. L., Day, J. D., & Jones, R. S. (1983). The development of plans for summarizing texts. Child Development, 54, 968-979.

Butkowsky, I. S., & Willows, D. M. (1980). Cognitive-motivational characteristics of children varying in reading ability: Evidence of learned helplessness in poor readers. Journal of Educational Psychology, 72, 408-422.

Cambourne, B. L., & Rousch, P. D. (1982). How do learning disabled children read? Topics in Learning and Learning Disabilities, 4, 59-68.

Collins, A., Brown, J. S., & Larkin, K. M. (1980). Inference in text understanding. In R. J. Spiro, B. C. Bruce, & W. F. Brewer (Eds.), Theoretical issues in reading comprehension. Hillsdale, NJ: Lawrence Erlbaum Associates.

Dennett, D. C. (1983). Intentional systems in cognitive ethology: The "Panglossian paradigm" defended. Behavioral and Brain Sciences, 6, 343-390.

Doehring, D. G., Trites, R. L., Patel, P. G., & Fiedorowicz, C. A. (1981). Reading disabilities: The interaction of reading, language, and neuropsychological deficits. New York: Academic Press.

Durkin, D. (1979). What classroom observations reveal about reading comprehension instruction. Reading Research Quarterly, 14, 481-533.

Fielding, L. G., Wilson, P. T., & Anderson, R. C. (in press). A new focus on free reading: The role of trade books in reading instruction. In T. E. Raphael & R. Reynolds (Eds.), Contexts of literacy. New York: Longman.

Fisk, J. L., Finnell, R., & Rourke, B. P. (1985). Major findings and future directions for learning disability subtype analysis. In B. P. Rourke (Ed.), Neuropsychology

of learning disabilities (pp. 331-341). New York: Guilford Press.

Franks, J. J., Vye, N. J., Auble, P. M., Mezynski, K. J., Perfetto, G. A., Bransford, J. D., Stein, B. S., & Littlefield, J. (1982). Learning from explicit vs. implicit text. Journal of Experimental Psychology: General, 111, 414-422.

Frederiksen, J. R., Warren, B. M., & Rosebery, A. S. (1985). A componential approach to training reading skills: Part I. Perceptual units training. Cognition and Instruction, 2, 91-130.

Gaskins, I. W., & Baron, J. (1985). Teaching poor readers to cope with maladaptive cognitive styles: A training program. Journal of Learning Disabilities, 18, 390-393.

Glushko, R. J. (1981). Principles for pronouncing print: The psychology of phonography. In A. M. Lesgold & C. A. Perfetti (Eds.), Interactive processes in reading. Hillsdale, NJ: Lawrence Erlbaum Associates.

Gough, P. B., & Hillinger, M. L. (1980). Learning to read: An unnatural act. Bulletin of the Orton Society, 30, 179-196.

Gould, S. J., & Lewontin, R. (1979). The spandrels of San Marco and the Panglossian paradigm: A critique of the adaptationist programme. Proceedings of the Royal Society (London), B205, 581-598.

Hiebert, E. H. (1983). An examination of ability grouping for reading instruction. Reading Research Quarterly, 18, 231-255.

Huberich, P. G. (1967). The master system of short method arithmetic and mechanical calculations simplified. Chicago: Stein Publishing House.

Leinhardt, G., Zigmond, N., & Cooley, W. W. (1981). Reading instruction and its effects. American Educational Research Journal, 18, 343-361.

Licht, B. G. (1983). Cognitive-motivational factors that contribute to the achievement of learning-disabled children. Journal of Learning Disabilities, 16, 483-490.

Mattis, S. (1981). Dyslexia syndromes in children: Toward the development of syndrome-specific treatment programs. In F. J. Pirozzolo & M. C. Wittrock (Eds.), Neuropsychological and cognitive processes in reading (pp. 93-107). New York: Academic Press.

Miramontes, O., Cheng, L., & Trueba, H. T. (1984). Teacher perceptions and observed outcomes: An ethnographic study of classroom interactions. Learning Disability Quarterly, 7, 349-357.

Naidoo, S. (1981). Teaching methods and their rationale. In G. T. Pavlidis & T. R. Miles (Eds.), Dyslexia research and its application to education. pp. 263-287. Chichester: Wiley.

Perfetti, C. A., & Roth, S. (1981). Some of the interactive processes in reading and their role in reading skill. In A. M. Lesgold, & C. Perfetti (Eds.), Interactive processes in reading (pp. 269-297). Hillsdale, NJ: Lawrence Erlbaum Associates.

Scardamalia, M., & Bereiter, C. (1983). Child as co-investigator: Helping children gain insight into their own mental processes. In S. Paris, G. Olson, & H. Stevenson (Eds.), Learning and motivation in the classroom (pp. 61-82). Hillsdale, NJ: Lawrence Erlbaum Associates.

Schank, R. C. (1979). Interestingness: Controlling inferences. Artificial Intelligence, 12, 273-297.

Siegel, L. S. (1985). Phonological deficits in children with reading disabilities. Paper presented at American Society for Research in Child Development, Toronto.

Stanovich, K. (1980). Toward an interactive-compensatory model of individual

differences in the development of reading fluency. Reading Research Quarterly, 16, 32-71.

Thies, A. P. (1985). Neuropsychological approaches to learning disorders. Review of Research in Education, 12, 91-119.

Torgesen, J. K. (1982). The learning disabled child as an inactive learner: Educational implications. Exceptional Education Quarterly, 1, 45-52.

Vaillant, G. E. (1977). Adaptation to life. Boston: Little, Brown.

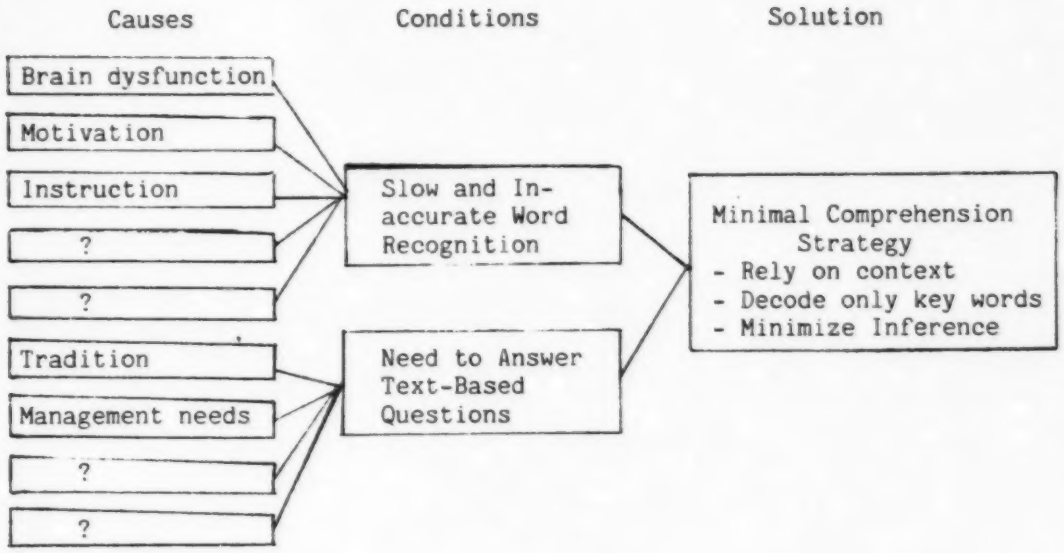
van Dijk, T. A., & Kintsch, W. (1983). Strategies of discourse comprehension. New York: Academic Press.

Venezky, R. L. (1976). Theoretical and experimental base for teaching reading. The Hague: Mouton.

Wong, B. Y. L., & Jones, W. (1982). Increasing metacomprehension in learning-disabled and normally-achieving students through self-questioning training. Learning Disability Quarterly, 5, 228-240.

Figure Caption

Figure 1. Model showing convergence of multiple causes on a single adaptive strategy.


Causes
Conditions
Solution
Brain dysfunction
Motivation
Instruction
?
?
Tradition
Management needs
?
?
Slow and In-accurate Word Recognition
Need to Answer Text-Based Questions
Minimal Comprehension Strategy
- Rely on context
- Decode only key words
- Minimize Inference